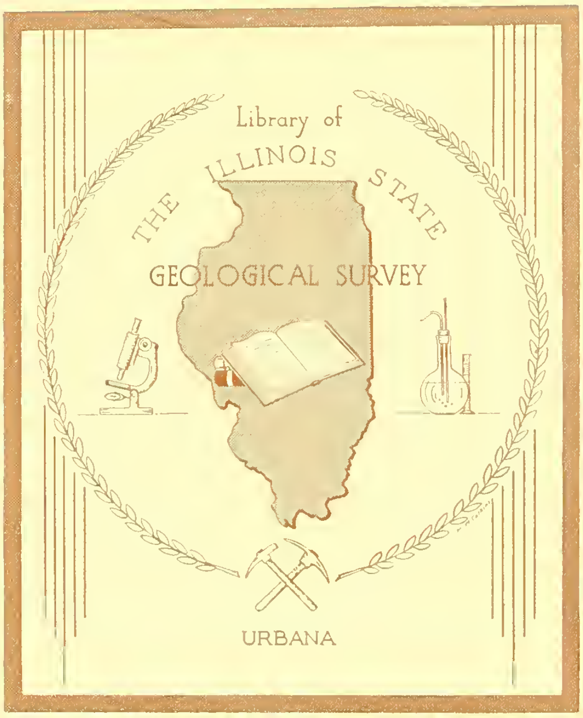

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ENVIRONMENTAL GEOLOGY NOTES

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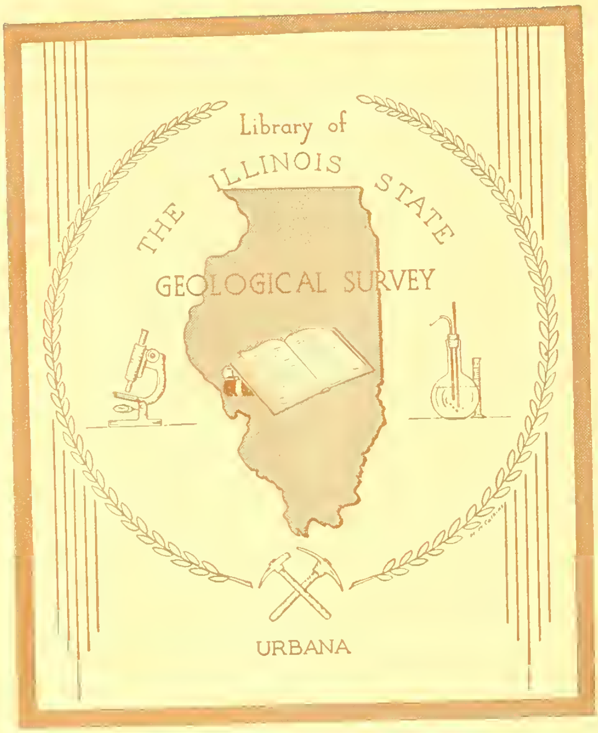
GEOLOGY FOR PLANNING IN DE KALB COUNTY, ILLINOIS

Compiled by David L. Gross

ILLINOIS STATE GEOLOGICAL SURVEY

JOHN C. FRYE, Chief • Urbana 61801



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GEOLOGY FOR PLANNING IN DE KALB COUNTY, ILLINOIS

Compiled by David L. Gross

INTRODUCTION

De Kalb County is a predominantly rural county in northern Illinois, situated approximately 60 miles west of Chicago. The city of De Kalb, the site of Northern Illinois University, is located in the center of the county. With a growing university, a rapidly developing industry, and a location half way between the metropolitan areas of Chicago and Rockford, De Kalb County's population will probably continue to grow rapidly. This report is concerned with geologic data that can be useful in planning for the expected population growth.

Rapid expansion of population and industry throughout the nation has caused and will continue to cause problems in land use. These problems were described by Frye (1967), and Hackett and McComas (1969, p. 2) enumerated them as follows:

> (1) Conflict between urban, agricultural, and mineral-resource development uses in the more populated part of the county. The competition for available land will grow in intensity and affect increasingly greater areas of the county with future growth; (2) An increase in financial losses resulting from damage to private and public property as a consequence of uncontrolled building in areas with unstable conditions, poor natural drainage, or periodic flooding; (3) A rapid increase in the amount and variety of waste products produced within the county, requiring more stringent regulations and controls relating to disposal; and (4) Destruction and impairment by uncontrolled development of some of the aesthetic features of the landscape.

To a large extent, these problems result from a lack of knowledge of geologic conditions. To provide this type of information, the Illinois State Geological Survey publishes a continuing series of environmental geology reports. Previously published studies include descriptions of the Hennepin region (McComas, 1968) and McHenry County (Hackett and McComas, 1969) and 32 Environmental Geology Notes, including one on the Naperville region (Hackett, 1968). Studies of several additional areas in the state are now under way at the Geological Survey.

Purpose and Scope

The study of De Kalb County was begun in November 1969 when John L. Henne of the De Kalb County Planning Department requested the Illinois State Geological Survey to furnish geologic information on the county relative to waste disposal, ground-water availability, sand and gravel resources, and suitability of the land for highway and subdivision development and for septic systems. The report to the Planning Department included maps showing surficial deposits, ground-water resources, sand and gravel resources, conditions for solid-waste disposal, and suitability of the land for general construction. The maps were on a scale of 1:125,000 (about 2 miles to the inch), the largest scale practical for showing the available geologic information, and are suitable for use in developing a county plan. For this report the maps were reduced to a scale of 1:250,000, or 4 miles to the inch, and serve to illustrate the type of geologic work done for an areal planning project.

A study of the suitability of the land for septic systems is not included here because the Soil Conservation Service of the U. S. Department of Agriculture is preparing a report on that subject. In a natural-resource approach to planning, pedologists, biologists, ecologists, and hydrologists, as well as geologists, all have specialized contributions to make.

Methods

The collection and interpretation of geologic data for submission to the De Kalb County Planning Department involved three steps:

1) Differentiation of all geologic units on the basis of composition and physical properties by means of surficial mapping, subsurface studies, and supporting laboratory analyses.
2) Evaluation of these geologic units in terms of their mineral resources and their engineering and hydrologic properties.
3) Preparation of maps based on the collected data, in which areas are graded for specific land uses.

Most of the basic data for the first step of the De Kalb County report had been collected, and some of it had been published, before the request was received. The glacial geology of northern Illinois was described by Frye et al. (1969), Kempton (1963), Kempton and Hackett (1968), and McGinnis, Kempton, and Heigold (1963). Anderson (1964) reported the sand and gravel resources of De Kalb County, and Bradbury (1965) mapped and discussed the county's dolomite resources. In addition, unpublished data were available in the files of the Illinois State Geological Survey. Only the glacial geology map required original field work, which was done by John P. Kempton, in close cooperation with Kenneth C. Hinkley of the U. S. Soil Conservation Service.

The second step, the evaluation of the geologic units, was a team effort involving specialists in several aspects of geology. John P. Kempton wrote the sections on general geology (figs. 1 and 2) and ground-water geology (fig. 3); Richard C. Anderson mapped the sand and gravel resources and Norman C. Hester evaluated them (fig. 4); James C. Bradbury contributed the section on limestone resources; Frank B. Sherman conducted the waste-disposal study (fig. 5); Paul B. DuMontelle prepared the section on suitability of the land for general construction (fig. 6); and David L. Gross was in charge of compiling and editing the various sections. Jean Peterson assisted in the preparation of the maps and manuscript.

The third step, the preparation of interpretative maps, involved a color coding system first developed by Quay (1966) for presenting information about soils. The system borrows from the traffic stop light the scheme of using green for go (favorable conditions), yellow for caution, and red for stop (unfavorable conditions or severe problem areas). In this report the colors are represented by the letters G, Y, and R. Three shades (numbered 1, 2, and 3) of each of the basic colors may be used to represent different kinds of limitations within the color group. For example, a classification of G-1 (Green-one) indicates either an area with the fewest limitations or the best resources, whereas R-3 (Red-three) indicates either an area with the most problems or the least valuable resources.

Each interpretative map (figs. 3, 4, 5, and 6) is accompanied by an extensive explanation that shows how the color scheme is applied to indicate the variations in suitability of areas for the particular type of information being mapped.

GEOLOGY

In De Kalb County the drainage, topography, and unconsolidated surficial materials are mainly the result of the action of glacial ice and running water. The layered bedrock (fig. 1, Units 14-16) lies below the unconsolidated surficial deposits at depths generally ranging from 100 to 300 feet. Locally in the southwestern part of the county, as much as 600 feet of unconsolidated material overlies the bedrock, while in the northwestern part of the county and in a small area southeast of Sycamore, such materials are less than 50 feet thick, with bedrock exposed in a few quarries and roadcuts.

The major topographic features, although locally controlled by the bedrock where the unconsolidated glacial deposits are thin, were formed by the last glaciers that covered De Kalb County. These topographic features include two broad, arcuate, hilly ridges (end moraines) that cross the county from east to southwest, large knobs and ridges of sand and gravel, somewhat flat or gently rolling areas (till plains), and the major valleys, once the major

EXPLANATION FOR FIGURE 1
SURFICIAL DEPOSITS OF DE KALB COUNTY MAPPED TO A DEPTH OF 20 FEET

Unit	General Category	Material
1	Organic sediments	Peat and muck
2	Alluvium	Water-laid sand and silt; some gravel; may be locally organic-rich; >5 feet thick; occurs mainly in narrow bands adjacent to principal streams; mostly Recent stream deposits, includes some local slopewash
3	Loess	Wind-laid silt >4 feet thick
4	Ablation and ice-contact deposits (late glacial and post-glacial deposits)	Non-compacted sandy, silty, till >5 feet thick, partially reworked by water; contains some sand and gravel lenses
5		Elevated flat-topped mounds composed principally of silt with some interbedded sand and gravel, >5 feet thick; local areas of underlying till exposed between mounds
6		Lacustrine and alluvial silt and sand deposits (includes areas of Unit 2 along principal streams not differentiated at present)
7	Glacial outwash (includes some ice-contact deposits)	Medium- to coarse-grained gravel and sand; small hills of Unit 7 not mappable at present scale are indicated by X
8		Sand with fine gravel, in part poorly sorted
9	Glacial till	Elburn till - yellowish brown, tan to gray, sandy, silty, frequently quite gravelly; local inclusions of sand and gravel and pink till
10		Bloomington till - pink, reddish brown to reddish gray, sandy silt, somewhat more clayey than Unit 9, uniform
11		Esmond till - yellowish brown, brownish gray to gray, clayey silt to silty clay, often somewhat sandier near top
12		Capron till - reddish brown to pinkish gray clayey silt to silty clay, locally sandy at top
13		Argyle till - pinkish brown to pinkish gray, gravelly sand, hard, compact
14	Bedrock	Alexandrian (Silurian) dolomite
15		Maquoketa Group (Ordovician), shale with interbedded dolomite
16		Galena and Platteville Groups (Ordovician), dolomite

$\frac{6}{\frac{7}{9}}$ Uppermost 20 feet of sediment includes Unit 6 over Unit 7 over Unit 9

X Small hill of Unit 7

▲ Bedrock outcrop or quarry

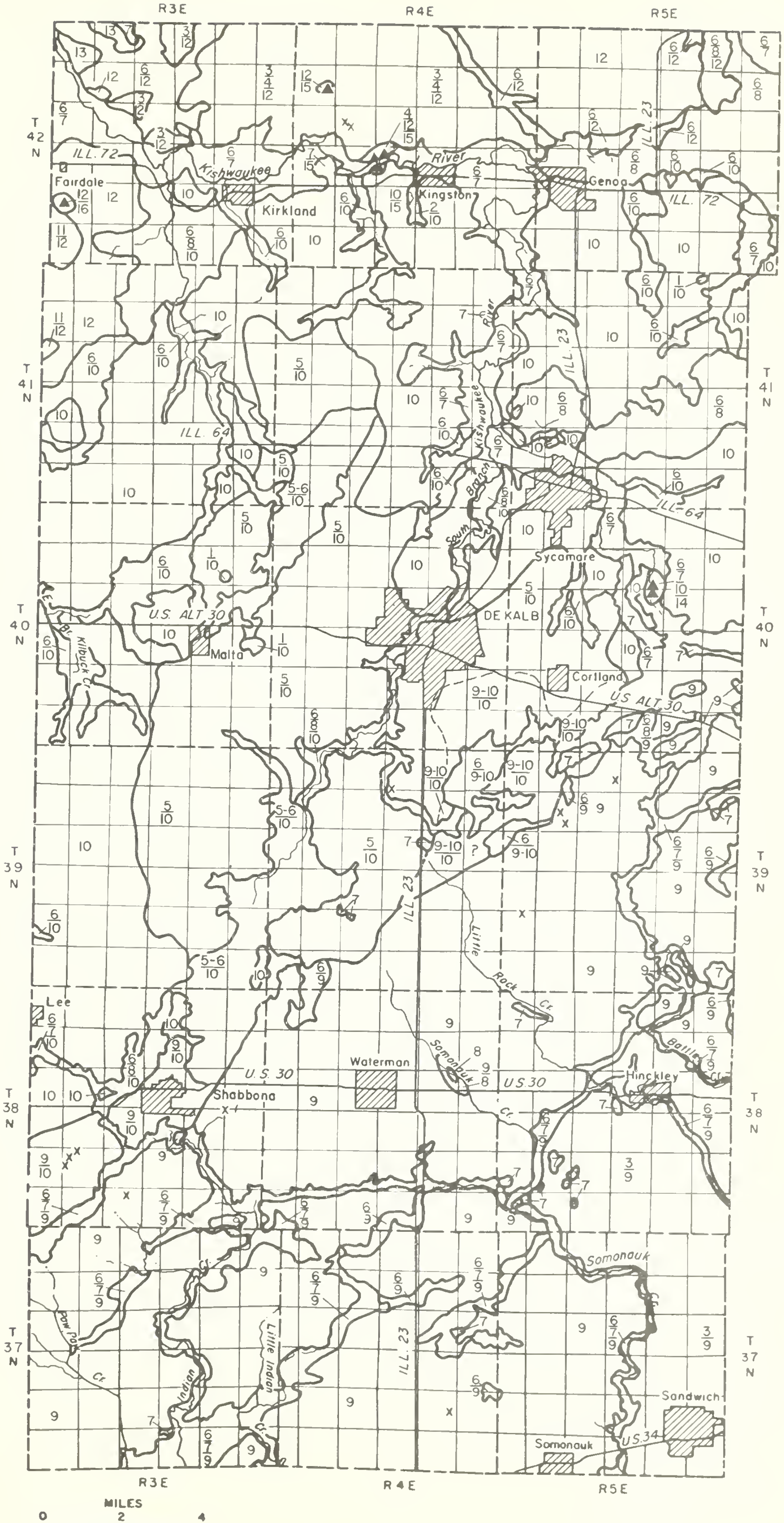


Fig. 1 - Surficial deposits of De Kalb County mapped to a depth of 20 feet.

John P. Kempton

drainageways for meltwaters from the glaciers, that are now filled with sand and gravel (valley trains). During the late stages of glacial melting, many lakes were formed in which fine-grained sediments were deposited.

Unconsolidated Surficial Deposits

The unconsolidated deposits are the materials that exert the main physical control on man's activities in De Kalb County. They can be grouped into six categories (fig. 1), listed in order of general abundance and significance in the county. The first four are glacial in origin: (1) glacial till, deposited directly by the glaciers; (2) glacial outwash, materials carried away from the glaciers by meltwater; (3) ice-contact and ablation drift, materials that were deposited when the glacial ice melted and were to some degree washed and sorted by the meltwaters; (4) loess, wind-blown silt derived from the outwash; (5) alluvium, deposited mainly along streams by running water or by slopewash, and (6) organic sediments, principally peat and muck, composed of partly decomposed vegetation that accumulated in poorly drained areas during post-glacial times. In the explanation for figure 1, the order in which the deposits are listed is the general sequence of occurrence in the county. The upper units are younger than the lower units.

Glacial Till (Units 9-13)

Of the deposits at or near land surface in De Kalb County, glacial till (Units 9-13) is by far the most abundant (fig. 1). It is within 20 feet of the surface in more than 90 percent of the county. The till units are discussed in order, from youngest to oldest. Till is unsorted debris composed of pebbles, cobbles, and large boulders imbedded in a matrix of clay, silt, and sand. Tills deposited from each of the numerous glaciers that advanced across De Kalb County have properties that distinguish them from each other, and most of them display physiographic characteristics that also are distinctive.

The Elburn till (Unit 9), which blankets the southern third of the county, is relatively thin, averaging little more than 30 feet thick. It is yellowish brown, tan, or gray. Although a predominantly sandy, silty till, it is locally quite gravelly and in some places contains inclusions of sand and gravel and the pink Bloomington till (Unit 10) that lies below it. The end moraine at its outer border is very hilly or knobby, many of the hills being composed of sand and gravel with till inclusions.

The Bloomington till (Unit 10) is a relatively uniform, silty, sandy till that normally contains noticeably more clay than the Elburn till and is pink, reddish brown, or reddish gray. It is the thickest till of the region, averaging 60 feet or more.

The Esmond till (Unit 11) in De Kalb County is found only in small patches in the northwestern two townships (T. 41 N., R. 3 E., and T. 42 N., R. 3 E.). It is probably no more than 20 feet thick and is a clayey silt to silty clay till, often somewhat sandier at the top.

The Capron till (Unit 12) covers only portions of the northern three townships. It is reddish brown to pinkish gray and is a clayey silt to silty clay till, locally sandy at the top. It probably averages less than 30 feet thick.

The Argyle till (Unit 13) is a sandy, gravelly till, the coarsest grained till in the county. It is generally quite hard and compact and ranges from pinkish gray to pinkish brown. It is limited to the northwest corner of the county.

Glacial Outwash (Units 7-8)

During the periods when the glaciers melted, sediment-laden meltwaters flowed away from the ice across the upland surfaces or down the valleys, covering or filling these areas with deposits of gravel, sand, and silt. Streams with the greater velocity carried and deposited sand and gravel, while others deposited only silt and sand. Most sand and gravel outwash in the county is covered by varying thicknesses of silt or sandy silt (Unit 6) that was deposited either during the final stages of melting of the glaciers as the meltwaters ebbed, or later when the present streams flooded.

Much of the outwash (Units 7 and 8) shown on the geologic map (fig. 1) was derived from the melting of the same glacier that deposited the Elburn till. The principal coarse-textured outwash (Unit 7) from this glacier was carried northward along the Kishwaukee River drainage system, beginning just southeast of Cortland and continuing northeast of Sycamore to Genoa, westward to the vicinity of Kirkland, and then northwestward out of the county. The outwash ranges from less than 30 feet thick in some areas between Cortland and Genoa to more than 50 feet thick, particularly in the area north and northwest of Kirkland.

During later phases of melting, outwash from the Elburn glacier formed channels around and across the melting ice in the southern third of the county, gradually draining southward as the ice disappeared. These channels therefore contain relatively thin, narrow, sand and gravel deposits, some of which (Unit 8) are not as coarse or as well sorted as the Kishwaukee deposits (Unit 7).

Some outwash is probably related to the glacier that deposited the Bloomington till (Unit 10). It is present northeast of Sycamore, east of Genoa, and in the drainageways south of Kirkland and north of Malta. These deposits generally contain only small amounts of gravel, locally may be as much as 40 feet thick, and are also included in Unit 8.

Ablation Drift and Ice-Contact (Units 4-6)

Some deposits that are formed during the melting or wasting of a glacier are not completely sorted by water or carried away as outwash. They do, however, undergo some movement and sorting and are called ablation drift. As the ice melts downward, rock debris that was frozen in the ice is left as a veneer on its surface, and the meltwater may cause it to slump or slide over the surface of the ice. Ice not coated with debris melts down faster and forms basins that fill with meltwater and accumulate sediment. At the surface of a till, therefore (generally within the upper 10 feet of the tills in De Kalb County), there are scattered or extensive till deposits that are sandy or looser in texture than the underlying till. Some of them contain poorly sorted sand and gravel (Unit 4), others are flat-topped mounds (Flemal, Hinkley, and Hessler, 1969) of water-laid silt (Unit 5), and still others are lacustrine and alluvial silt and sand (Unit 6) that fill broad, low areas above the tills or along the valleys.

As a glacier melts, some sand and gravel is carried into crevasses in the ice, through ice tunnels, or is deposited in depressions on the ice. These deposits, called ice-contact drift, generally form hills or ridges of gravel after the ice melts. Most occur where the outer margin of the glacier was melting rapidly and the greatest concentrations of meltwater were present. Such deposits are composed principally of sand and gravel and occur as isolated hills or ridges, mainly in the southern half of the county. They were formed during the melting of the glaciers that deposited the till. Because the ice-contact deposits are similar in character to the coarser textured outwash, they are included in Unit 7 (fig. 1).

Loess (Unit 3)

When glacial outwash was being deposited, it was subjected to wind erosion. Large quantities of silt and fine sand were picked up and deposited on the uplands adjacent to major valleys. In De Kalb County, the closest major source of this material, called loess, was probably the Rock River Valley, although some probably came from the Mississippi Valley to the west, and small quantities were derived locally from the Kishwaukee River Valley.

Loess (Unit 3) blankets nearly the entire surface of De Kalb County, although it seldom is more than 3 or 4 feet thick. It is mapped in a few places in the northernmost part of the county and in a small area in the southeastern part where it is consistently more than 4 feet thick.

Alluvium (Unit 2)

When the streams of the county are flooding, silt, clay, sand, and occasionally gravel are deposited along the floodplains. These alluvial deposits (Unit 2) are found along nearly all streams in De Kalb County. Some are very dark gray because they contain organic material. Although quite thin in some places, they can be identified and mapped. However, mapping of the alluvium in De Kalb County has not been completed, and much of it has been mapped with Unit 6 (fig. 1).

Organic Sediments (Unit 1)

Only very small areas of De Kalb County contain organic sediments, which accumulated in poorly drained depressions. These deposits, usually referred to as peat or muck (Unit 1), form in areas that contain water throughout the year and are normally ground-water discharge areas. In addition to the three areas shown on the surficial geology map (fig. 1), smaller, poorly drained areas occur in several places in the county, although they generally contain no organic sediments of any significance. The floodplains may contain some organic-rich alluvium.

Bedrock

The bedrock (Units 14-16) is exposed in several places in the northern half of De Kalb County, but in most of the county it directly underlies unconsolidated deposits from a few feet to as much as 600 feet thick. The bedrock geology of the region and the topography of the bedrock surface were summarized by McGinnis, Kempton, and Heigold (1963). Bradbury (1965) described most of the bedrock exposures within the county and mapped the areas where the bedrock is within 100 feet of land surface. A geologic column of the major bedrock units appears in figure 2. All bedrock formations above the Ironton-Galesville Sandstone lie directly below the glacial deposits at some place within the county.

Three of the bedrock units are known to be exposed in the county. Dolomite of Silurian age (fig. 1, Unit 14) is within 50 feet of the surface about 3 miles southeast of Sycamore and is also exposed in a quarry in that area. In the northwestern part of the county, rocks of Ordovician age (the Maquoketa Group, Unit 15, and the Galena Group, Unit 16) at some places are within 50 feet of land surface. Dolomite of the Galena Group is exposed in an active quarry just south of Fairdale, and dolomite of the Maquoketa Group is exposed in an abandoned quarry 3 miles northwest of Kingston, in roadcuts, and along the Kishwaukee River about 1 mile northwest of Kingston.

RESOURCES

Ground Water

Ground water is available in De Kalb County for most purposes, including municipal, industrial, domestic, and livestock uses. In fact, ground water is available at some depth below land surface in every part of the county (fig. 3). However, a broad range of geologic conditions in the county controls the depth and the type of materials from which water can be obtained.

Ground-water availability is controlled by the distribution, thickness, and character of the geologic units present in the county. The principal aquifers are sand and gravel in the unconsolidated deposits and fractured limestone or dolomite and permeable sandstone in the bedrock. Sand and gravel aquifers in De Kalb County are widely distributed, both areally and vertically, throughout the county. However, in several areas sand and gravel is absent or is too thin to be an aquifer. Sand and gravel occurs principally in the glacial meltwater channels. The deposits therefore lie along present drainageways or drainageways buried under younger glacial deposits.

The principal surficial sand and gravel aquifers (those within 10 feet of land surface) in De Kalb County are found along the Kishwaukee Valley and its tributaries and, to a certain extent, the valleys of Indian, Little Rock, and Somonauk Creeks in the southern part of the county. The deeper sand and gravel aquifers are found principally in the thick drift that fills former valleys cut into the bedrock (McGinnis, Kempton, and Heigold, 1963) or into older glacial deposits. These buried outwash-filled valleys occur throughout the central part of the county, from north to south, and in the southeastern part of the county in the vicinity of Hinckley and Sandwich. Along the buried bedrock valley in the central and southwestern parts of the county, the tops of the aquifers are locally 400 feet deep.

The bedrock units below the glacial deposits consist of a sequence of sandstones, dolomites, and shales that range in depth from a few feet below the surface to as much as 600 feet. Some are exposed in roadcuts and quarries. In general, the bedrock is shallowest in the northwestern third of the county, where dolomites less than 100 feet from the surface may be particularly productive. However, many domestic and farm wells obtain water from dolomites in parts of the northern, central, and southeastern parts of the county where the drift cover is thicker.

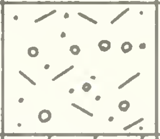
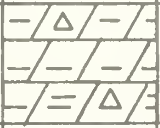
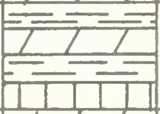
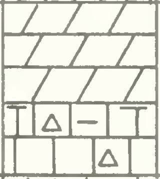
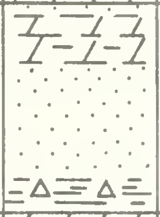
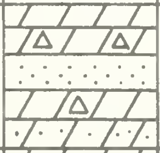
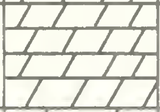
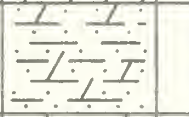
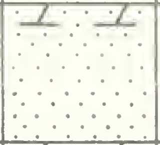
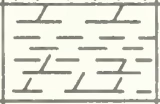
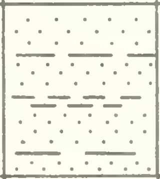
The deeper sandstones (fig. 2), which occur at depths ranging from about 400 feet in the northwestern part of the county to 600 or more feet deep in the east-central part of the county, are the most dependable sources of ground water. These sandstones are found in at least three different levels and extend to a depth of more than 2000 feet. The top of the Glenwood—St. Peter Sandstone, the uppermost of these sandstones, is between 300 and 400 feet below the surface in the northwestern part of the county, where, in the deep bedrock valley in that area, it directly underlies the glacial deposits. Where it occurs directly below fairly thick, extensive sand and gravel deposits, they may supply a considerable amount of vertical recharge. This is a highly favorable situation for the development of large ground-water supplies.

The two sandstones below the Glenwood—St. Peter (fig. 2), the Ironton-Galesville and the Mt. Simon, are both highly productive aquifers. The Ironton-Galesville Sandstone, about 500 feet below the top of the Glenwood—St. Peter, is probably the most productive of the three. The Mt. Simon Sandstone, more than 1500 feet thick, is about 1000 feet below the top of the Glenwood—St. Peter. However, below the upper 200 feet of the Mt. Simon, water quality may deteriorate with depth. South of a line between Lee and Sandwich, in the southern third of the county, the Glenwood—St. Peter Sandstone is absent and the Ironton-Galesville is the upper sandstone aquifer at depths ranging from 400 to 600 feet.

Other areas considered highly favorable for development of large ground-water supplies at relatively shallow depths are those in which sand and gravel occur extensively as surficial deposits. Such areas, although not numerous in De Kalb County, occur principally in the northwestern part of the county. Local areas of surface sand and gravel, possibly as much as 60 feet thick, may occur along some of the valleys in the central and southern parts of the county.

A third possible type of source of moderate to large supplies of ground water is areas where buried sands and gravel more than 50 feet thick are present

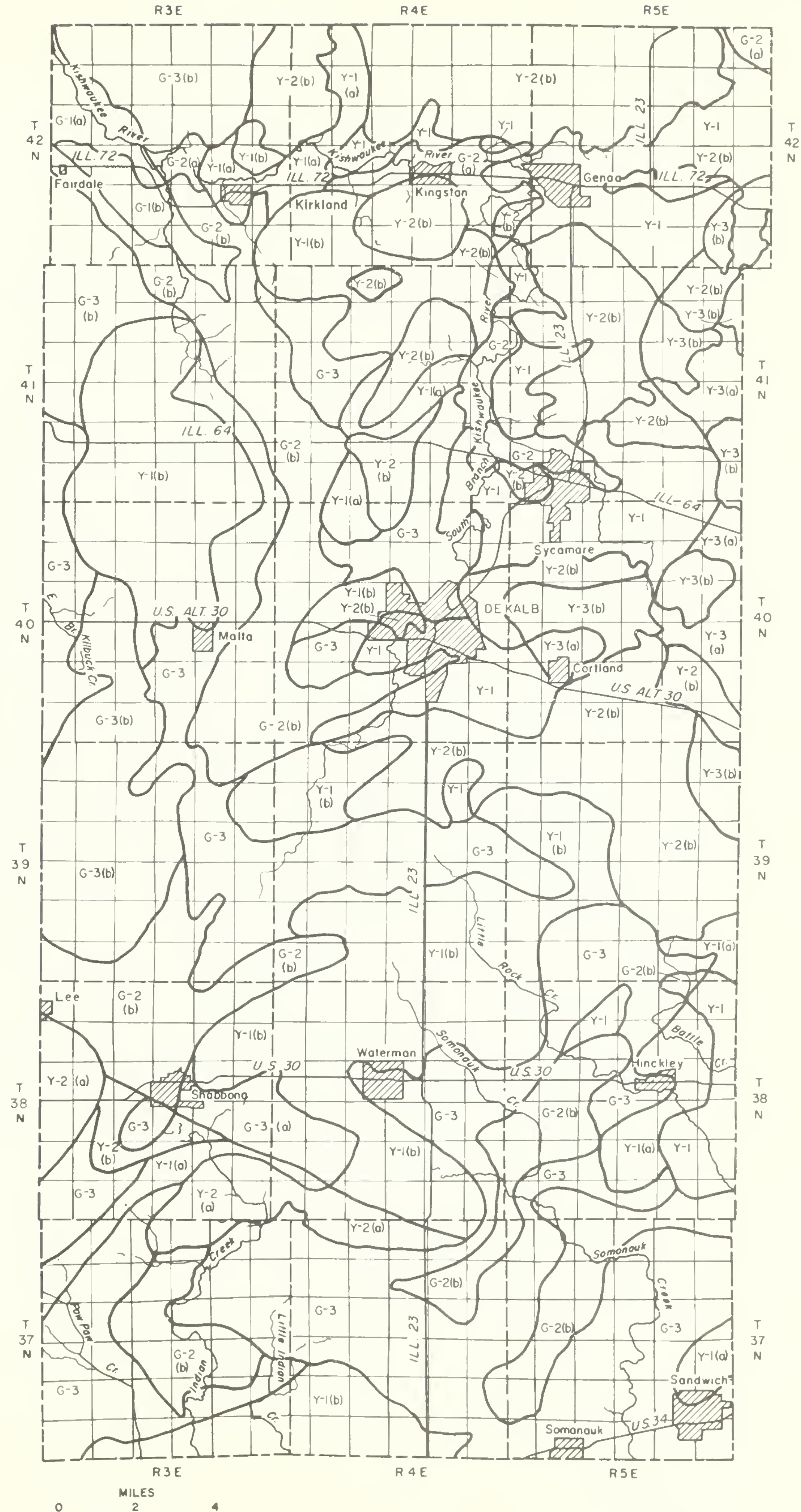
FIGURE 2—GENERALIZED COLUMN OF GEOLOGIC FORMATIONS IN DE KALB COUNTY

System or Series	Hydrogeologic units and thickness (ft)	Graphic log	Rock type	Water-yielding characteristics
PLEISTOCENE	Drift 0 - 600		Unconsolidated glacial deposits, loess and alluvium	Yields variable; largest from thick sand and gravel beds
SILURIAN	Alexandrian 0 - 50		Dolomite, cherty, shale partings	Local occurrence, small supplies
ORDOVICIAN	Maquoketa 0 - 200		Shale with limestone and dolomite beds	Small supplies from dolomite and fractured shale
	Galena-Platteville 0 - 350		Dolomite; thin shale in middle; some limestone and chert in lower part	Small to moderate supplies where not overlain by Maquoketa; large supplies where fractured
	Glenwood-St. Peter 0 - 500		Sandstone, fine to coarse; shale and some dolomite at top; locally cherty; red shale at base	Moderate to large supplies
	Prairie du Chien 0 - 300		Dolomite, sandy, cherty, interbedded with sandstone	Small to moderate supplies, locally large in SE part of county
CAMBRIAN	Eminence-Potosi 0 - 200		Dolomite, white, fine grained	May yield small amounts of water locally from fractures
	Franconia 80 - 130		Dolomite, sandstone, and shale	Generally not water-yielding; small supplies locally
	Ironton-Galesville 100 - 300		Sandstone, fine to medium grained, well sorted	Most productive bedrock aquifer in county; large supplies
	Eau Claire 200 - 450		Shale and siltstone, dolomitic	Generally not water-yielding
	Mt. Simon 1500 - 2500		Sandstone, coarse grained; lenses of shale and siltstone	Moderate to large quantities of water; water quality good at top but deteriorates with depth
PRECAMBRIAN			Granite	Not water-yielding

EXPLANATION FOR FIGURE 3

AQUIFER CONDITIONS IN DE KALB COUNTY

G-1	(a) Surficial sand and gravel more than 50 feet thick (b) Buried sand and gravel more than 50 feet thick Dolomite, generally less than 50 feet thick, below depth of 200 feet Sandstones 100-200 feet or more thick between depths of 300 and 2000 feet
G-2	(a) Surficial sand and gravel generally more than 15 and less than 50 feet thick (b) Buried sand and gravel generally more than 50 feet thick and between 100 and 300 feet deep Dolomite 50-200 feet thick below a depth of 200 feet Sandstones 100-200 feet or more thick between depths of 300 and 2000 feet
G-3	(a) Buried sand and gravel generally more than 15 feet and less than 50 feet thick between depths of 100 and 300 feet (b) Dolomite aquifer 100-300 feet thick, the top of which is between 50 and 300 feet deep Sandstones 100-200 feet or more thick between depths of 300 and 2000 feet
Y-1	(a) Surficial sand and gravel aquifers or buried sand and gravel less than 200 feet deep; varied in texture, thickness, and continuity; generally more than 15 feet thick (b) Shale and/or till 10-200 feet thick overlying dolomite aquifer Dolomite aquifer 50-300 feet thick whose top is generally less than 200 feet deep Sandstone aquifers between depths of 400 and 2000 feet
Y-2	(a) Dolomite aquifer below drift; aquifer not well jointed (b) Shale 10-200 feet thick below drift Surficial aquifers generally absent or highly variable; buried sand and gravel highly variable in texture, thickness, and continuity; generally less than 300 feet deep Sandstone aquifers between depths of 400 and 2000 feet
Y-3	(a) Sand and gravel aquifers varied in texture, thickness, and continuity; principally surficial (b) Sand and gravel aquifers generally absent; thin, shallow dolomite may be directly below drift Shale 10-200 feet thick overlying principal dolomite aquifer Sandstone aquifers between depths of 600 and 2500 feet



John P Kempton

Fig. 3 - Aquifer conditions in De Kalb County.

above fractured and permeable dolomites or highly permeable sandstones that lie no more than 400 feet from the surface.

The occurrence of relatively shallow sand and gravel deposits and the presence of dependable bedrock aquifers at relatively shallow depths, therefore, are the conditions considered most favorable for ground-water supplies. They are included in the G-1, G-2, and G-3 areas shown on the ground-water map (fig. 3). Areas where sand and gravel is thin or absent, where the bedrock formations are deep, or where the shallow bedrock aquifers are not dependable, are generally considered to have certain limitations, and, therefore, are marked Y-1, Y-2, and Y-3 on the map. The criteria used for the differentiation of ground-water potential were thickness of aquifer, depth to aquifer, and probable yield based on pumpage reports and on textural properties of the material.

The sandstones that occur at depths ranging from just below 300 feet in the northwestern portion of the county to depths of 600 feet or more in the east-central portion of the county actually occur throughout the whole county and can always be considered as a source of moderate to large ground-water supplies. The G and Y ratings given each area, therefore, are determined by the occurrence of other aquifers above these sandstones at shallower depths. Thus, even in the Y-3 areas, large ground-water supplies are generally obtainable in these sandstones at depths below 400 to 600 feet. The cost of drilling to these deep units and the cost of the large pumping lifts involved are likely to be excessive for small domestic and livestock wells. Wells for those uses are for the most part limited to the glacial drift and shallow dolomite aquifers.

Because of the numerous geologic conditions found in De Kalb County, it was necessary to subdivide the six G and Y ratings to provide more specific information about the conditions in each mapped area, even though the rating remained the same, by adding (a) and (b) after the numbers (fig. 3 Explanation). A Y-1 rating indicates both (a) and (b) conditions are probably present in that mapped area, but a Y-1 (a) rating means that the (b) condition is not applicable, and a Y-1 (b) rating excludes the (a).

Sand and Gravel

Most of the sand and gravel in De Kalb County (fig. 4) occurs as outwash in valley trains, in subglacial channels that start in and cut through end moraines, in ice marginal channels parallel to the outer edges of end moraines, and in a few broad plains that extend beyond the outer edges of end moraines (Anderson, 1964). Isolated hills of sand and gravel are scattered throughout the county.

The most favorable deposits of sand and gravel, in terms of thickness, cleanness, and lateral continuity are found in (1) the South Branch Kishwaukee River from the northwestern corner of the county to an area just southwest of Sycamore, and (2) the East Branch Kishwaukee River from the point of confluence with the South Branch just northwest of Sycamore to the margin of the county due east of Cortland. The deposits of both branches are generally more than 10 feet thick and underlie less than 10 feet of silt and clay overburden. The deposits are clean, and usually more than 10 percent of the total sample is more than 1 inch in diameter.

Sand and gravel, similar in grain size and cleanness to that described above, also occurs along the southern segment of Coon Creek in the northeastern part of the county and along Battle Creek north and west of Hinckley. This material is less important as a resource because it is generally less than 10 feet thick and usually less than 10 percent of it is more than 1 inch in diameter.

Many other tributaries and areas along the morainal fronts contain sand and gravel of good quality, but, because they are usually less than 10 feet thick and their lateral distribution is discontinuous, these areas are not at present considered as major sources of sand and gravel for De Kalb County.

Abundant sand deposits are found in the northeastern part of the county, but at present there is little commercial need for them because the supply of sand from the sand and gravel deposits is sufficient for the area's needs.

From a mineralogical standpoint, the quality of the gravel in De Kalb County is very good because of the low percentage of deleterious materials. Eighty to 95 percent of the gravel consists of dolomite and limestone.

Dolomite

Because of the thick cover of glacial drift, dolomite is a quarryable resource in only a few small areas in the northern part of the county (Bradbury, 1965). Dolomite of the Galena Group is quarried in the Macklin Brothers quarry 1 mile south of Fairdale; shallow dolomite of the Galena is present northwest of Kirkland; and dolomite belonging to the Edgewood Formation is quarried at the Elmer Larson, Inc., quarry 2 to 3 miles southeast of Sycamore. Although the outlier of Edgewood Dolomite appears to be sharply limited in area, drill cuttings from near-by water wells suggest that dolomite from the Fort Atkinson Formation in the Maquoketa Group, the next older unit, underlies the buried ridge that extends southwest and south from the quarry, and the dolomite could be shallow enough locally to warrant quarrying.

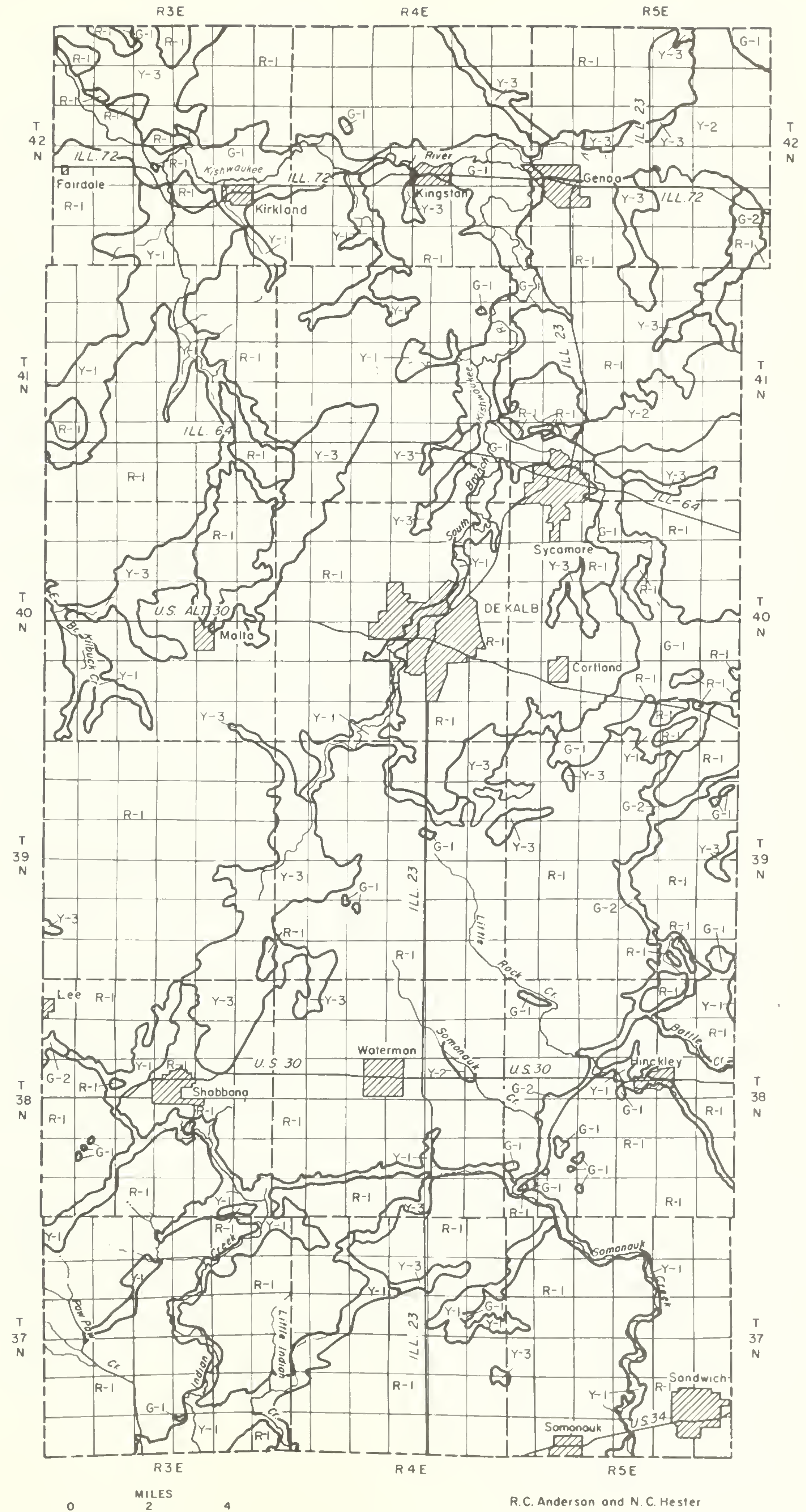
Information provided by quarry operators indicates that both the Galena and Edgewood meet specifications for bituminous concrete and portland cement concrete, and also the less rigid requirements of general crushed stone. There are no quarries operating in the Fort Atkinson, and no data on its performance as aggregate are available. However, drilling samples of the Fort Atkinson in the Illinois Geological Survey files indicate a relatively sound limestone. Agricultural limestone meeting the specifications set by the Agricultural Stabilization and Conservation Service is now being produced from the two operating quarries, and a single analysis of a limited thickness of the Fort Atkinson (Bradbury, 1965, table 2) suggests that this unit, too, may make good agricultural limestone.

EXPLANATION FOR FIGURE 4

SAND AND GRAVEL RESOURCES OF DE KALB COUNTY

G-1	Sand and fine- to coarse-grained gravel, generally more than 10 feet thick, usually covered by less than 10 feet of overburden: more than 10 percent is coarser than 1 inch in diameter, and more than 40 percent is coarser than 4 mesh (0.185 inch).
G-2	Sand and fine- to coarse-grained gravel; varies in thickness but generally less than 10 feet with less than 10 feet of overburden; usually less than 10 percent is coarser than 1 inch in diameter.
Y-1	Sand and fine- to coarse-grained gravel in small, discontinuous deposits; generally less than 10 feet thick.
Y-2	Predominantly sand with scattered fine gravel; probably of no immediate commercial value.
Y-3	Clays and silts with some sand; possibility of small isolated deposits of sand and gravel; poor prospect for sand and gravel resources.
R-1	Generally devoid of sand and gravel, although small discontinuous deposits may occur in some places.

Fig. 4 - Sand and gravel resources of De Kalb County.



EVALUATION OF AREA FOR LAND USES

Suitability of Area for Solid-Waste Disposal

Both the location of a site for solid-waste disposal and the operational procedures to be employed must be approved by the Illinois Department of Public Health. Solid wastes may be disposed of by contained high-temperature incineration, sanitary landfill, composting, and feeding garbage to swine. The sanitary landfill is the most frequently used disposal technique.

The primary consideration in approving a sanitary landfill site is the possibility of polluting either ground or surface water. According to regulations set up by the Illinois Department of Public Health (1966), sites shall be located so that:

1) no disposal takes place in standing water;

2) no disposal takes place in areas having high ground-water tables unless preventive measures are taken to safeguard the ground water;

3) no surface run-off flows into or through the operational or completed fill area;

4) no disposal takes place unless the subsoil material affords reasonable assurance that leachate from the landfill will not contaminate ground or surface water.

For evaluation of a waste disposal site, information is needed about the type and thickness of unconsolidated material at the site, the type of bedrock present, present sources and potential sources of water, and the topography of the site (Cartwright and Sherman, 1969, p. 7-13). In general, at least 30 feet of relatively impermeable material must occur between the base of any landfill operation and the top of any existing or potential ground-water aquifer. In De Kalb County, only the areas covered by clayey glacial till appear to meet this requirement consistently.

Figure 5 uses the traffic light scheme of designating as red, yellow, and green (R, Y, G) the relative probabilities for locating a suitable sanitary landfill site. Much of the area labelled G on the map should be suitable for landfill use. These areas are believed to have more than 50 feet of glacial till overlying any aquifer unit. Sand and gravels are relatively rare. One or two test borings would probably be required at a proposed site because reliable subsurface data are not available for every area.

The lack of favorable areas in the southern part of the county suggests that less favorable areas (Y-1, Y-2, Y-3) must be used for waste disposal. These areas commonly contain layers of sand, or sand and gravel, interbedded with glacial till and silt. Acceptable sites can be found in these areas, but the varied nature of the earth materials means that a very careful preliminary investigation will be required. An extensive test boring program would be necessary to find areas where sand and gravel is absent. Thin sand and gravel layers might be acceptable if there were reasonable assurance that they would never be developed as a source of water and that they would not serve as a path for leachate to reach surface streams.

Considerable difficulty should be expected if attempts are made to locate landfills in the R-1, R-2, and R-3 areas. In the R-1 areas, the surficial material is silt, sand, or sand and gravel. Such areas are along the existing surface drainageways, and the possibility of surface water pollution must be considered. Relatively impermeable till is usually found at a depth of less than 20 feet. A location where relatively impermeable silt overlies till would probably be acceptable for landfill purposes, but a rather extensive preliminary investigation would be necessary.

R-2 areas are believed to have less than 50 feet of glacial drift over the bedrock. As the bedrock in the county is generally capable of supplying enough water for individual residences, the requirement that at least 30 feet of relatively impermeable material occur between the base of any landfill and any underlying aquifer severely limits the landfill potential of these areas. Test borings to bedrock would be required at a potential site, and only if the unconsolidated materials overlying the bedrock proved to be clay till or silt would the site be safe to use.

Areas where the upper 20 feet of earth materials is silt, sand, or sand and gravel are marked R-3. Of these materials only thick deposits of silt might be acceptable for waste disposal sites. As much of the area is adjacent to the Kishwaukee River, it seems unlikely that suitable sites could be easily located.

Some locations that are naturally unfavorable can be improved by proper engineering. Laying out diversion ditches, tiling, diking, installing clay liners, and collection and treatment of leachate are possible approaches to be used at locations where natural safeguards are lacking. However, construction work of this kind can be expensive and is rarely employed.

Suitability of Area for General Construction

General construction refers to development of a subdivision, erection of small business structures, road building, and other construction projects of similar size. Although planners of such construction projects are primarily interested in the surficial materials, they must also be concerned with subsurface materials encountered in excavations for sewerage systems, basements, and water distribution systems.

Water conditions, composition of the soil unit, and the character of the slope are the principal factors influencing the selection of construction sites. Regions that are topographically low and areas that have a high water table and a potential for frequent flooding should be avoided. Quicksand or sandboils may develop when water under pressure is exposed at the surface or in an excavation.

Generally speaking, well graded, compacted till deposits and coarse, well drained alluvial deposits provide suitable construction sites, whereas

EXPLANATION FOR FIGURE 5

SUITABILITY OF DE KALB COUNTY AREA FOR SOLID-WASTE DISPOSAL

G	Suitable disposal sites probably available; areas of glacial till where there are no data suggesting the occurrence of sand or sand and gravel.
Y-1	Suitable disposal sites may be available; extremely varied material; primarily till with many inclusions of sand or sand and gravel.
Y-2	A few suitable disposal sites probably available; isolated sand or sand and gravel deposits; usually associated with extremely varied till.
R-1	Disposal sites are likely to pose pollution hazards unless special engineering precautions are taken; surficial silt, sand, or sand and gravel underlain by till at less than 20 feet.
R 2	Disposal sites are liable to pose pollution hazards unless special engineering precautions are taken; less than 50 feet of glacial drift over the bedrock surface; surficial material varies from sand to till.
R-3	Disposal sites are liable to pose pollution hazards unless special engineering precautions are taken; upper 20 feet of surficial material consists of silt, sand, or sand and gravel.

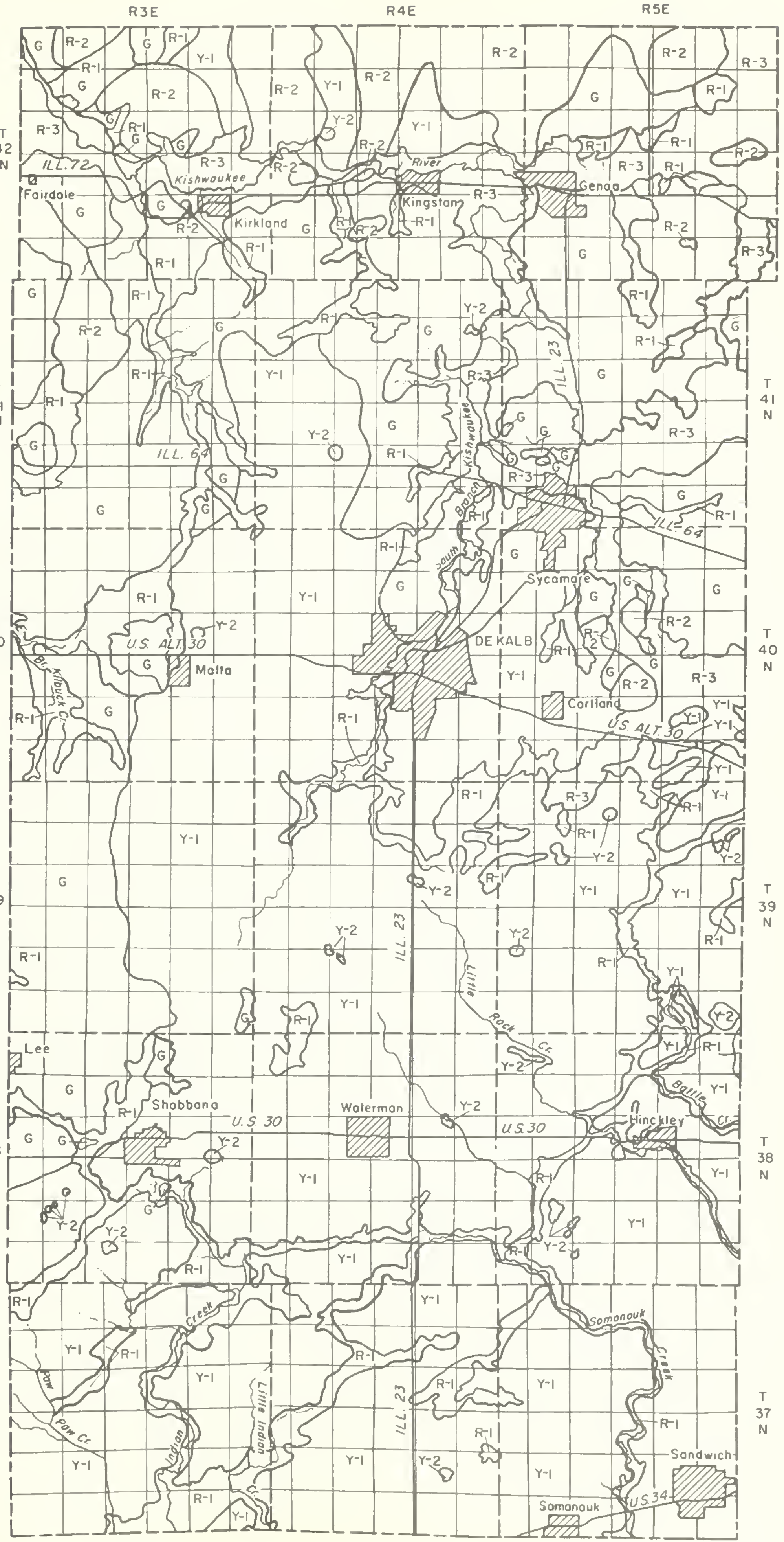
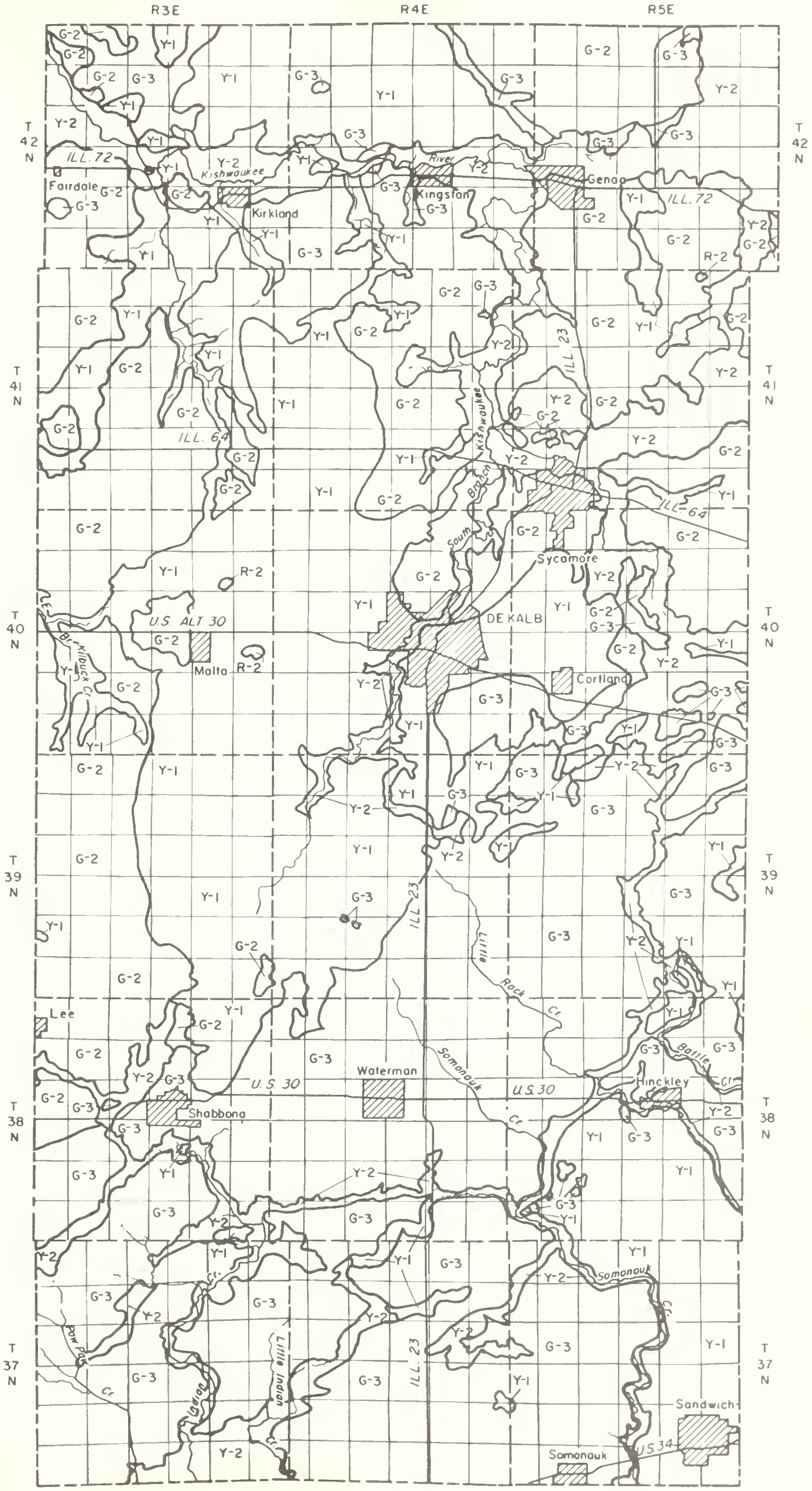


Fig. 5 - Suitability of De Kalb County area for solid-waste disposal.

EXPLANATION FOR FIGURE 6

SUITABILITY OF THE DE KALB AREA FOR GENERAL CONSTRUCTION

G-2	Areas of low to medium plasticity; medium to high compressive bearing strengths adequate for nearly all construction; moderate to low shrink-swell characteristics; water table generally low; sand and silt lenses may be encountered during excavation; till unit 13 may be difficult to excavate.
G-3	Areas of thin till having low to medium plasticity; bearing strengths adequate; moderate to low shrink-swell characteristics; exposed or near-surface bedrock will increase costs of excavation; underlying rock units should be protected from surface pollutants. The map unit also includes some areas of granular deposits with good internal drainage.
Y-1	Areas of varied material; may be granular with little or no plasticity; free-draining; low shrink-swell characteristics; water table may be less than 10 feet deep. Clayey silts with high plasticity, high dry strength, high shrink-swell characteristics, subject to frost heave. Drainage conditions and depth to stable material will affect the suitability of construction sites. Artesian water conditions in local sand deposits may cause foundation or excavation problems. Areas of gentle slopes generally provide adequate bearing strengths.
Y-2	Areas of varied materials like those in Y-1; depth of undesirable materials generally more than 10 feet; some areas subject to high water table or possible flooding; materials have poor drainage and low bearing strengths.
R-2	Areas of highly compressible organic materials or muck; ground-water levels at or near ground surface; interior drainage; very poor foundation material.



Paul B. DuMantelle

Fig. 6 - Suitability of De Kalb County area for general construction.

fine-grained, clayey or silty, poorly drained deposits are less desirable. Organic materials and clays can be squeezed and are termed "compressible." Such materials often cause foundations to settle, with resultant damage to the structures. Clays are the chief cause of the shrinking and swelling characteristics of soils, which also may prove detrimental to foundations. Water-saturated clay or silt zones provide a sliding surface, which may result in a landslide. A silty texture contributes to the frost susceptibility of soils because it allows water to move through them.

Most landscapes, unless adjacent to areas actively being eroded, such as stream banks, lake borders, or steep moraine fronts, develop natural, stable slopes. If, prior to construction, it becomes necessary to alter the natural slope of the land, careful consideration should be given to the settlement and stability of the resultant graded slopes.

Characteristics of the surficial materials in De Kalb County that affect engineering projects are listed in the explanation for figure 6. These units are coded G, Y, and R according to their engineering characteristics. The data used for evaluating the construction suitability of land in De Kalb County include the surficial geology map of De Kalb County (fig. 1), sand and gravel resource studies by Anderson (1964), and logs of borings made by the Illinois Division of Highways. No new samples were collected or tested for this study. The reports by Smith (1968) and McComas, Hinkley, and Kempton (1969) were used as a guide for descriptions of engineering properties.

Figure 6 indicates that most areas in De Kalb County are free from serious construction problems. A competent foundation engineer, however, should be engaged to evaluate construction sites, as his knowledge and experience can be invaluable in avoiding the less suitable areas.

DISCUSSION OF THE MAPS

The map of the surficial deposits (fig. 1) was basic to the study of environmental geology in De Kalb County, in as much as the interpretative maps were partly, or in some cases wholly, derived from it. The surficial deposits map delineates the deposits that occur within 20 feet of the surface and is based on the texture, mineralogy, color, weathering characteristics, and degree of compaction of the deposits.

All boundaries on the sand and gravel resources map (fig. 4) match the boundaries on the surficial deposits map (fig. 1). Not all the boundaries in figure 1 are significant from a sand and gravel resource point of view, but major changes in resource quality occur only at figure 1 boundaries. The geologic deposits were evaluated as sand and gravel resources on the basis of grain size, mineralogy, thickness, and depth of burial. The fine-grained glacial tills (silt and clay size) are of little use as a sand and gravel resource, but the coarse-grained outwash gravels are valuable. Thus, the glacial tills (fig. 1) are shown as R areas on the sand and gravel resources map (fig. 4), while the outwash units are labelled G.

The map indicating the suitability of the various areas of the county for general construction (fig. 6) bears a similar relation to the surficial deposits map (fig. 1). All boundaries shown in figure 6 match boundaries on the surficial deposits map, although not all figure 1 boundaries are relevant to construction conditions. The engineering properties of a geologic unit depend on the physical character and composition of the deposit as well as on its geologic history (including degree of compaction by overriding glacial ice and subsequent weathering). The physical and compositional factors are considered in the surficial deposits map (fig. 1); therefore, the engineering interpretation requires an evaluation of each of the units shown in the surficial deposits map but does not require remapping the boundary lines.

Surficial geology is the most important but not the only consideration in evaluating the county for solid-waste disposal sites (fig. 5). The thickness of the glacial drift, the character of the underlying bedrock, the general hydrologic flow system, and the regional use of ground water are all considered in evaluating conditions for solid-waste disposal. Therefore, the resultant waste disposal map resembles, but does not directly coincide with, the surficial deposits map.

The evaluation of ground-water resources depends on a combination of several factors, including the water-yielding characteristics of both the surficial deposits and the deeply buried bedrock and the quality of water they yield. Because it is more dependent on the character of the bedrock than are the other interpretative maps, the aquifer map does not closely resemble the others.

In the preparation of an environmental geology report, the map scale almost always represents a compromise. A county planner would prefer maps on a very large scale that have exceptionally accurate boundaries, but for two reasons this is not always practical. First, the map scale must be based on the accuracy and quantity of the available geologic data. Second, geologic deposits are naturally gradational and do not lend themselves to arbitrary boundaries. In many cases the sharp lines on geologic maps are actually dividing a single sequence that is continuously gradational in composition or thickness. Photographic enlargement of a geologic map is not the answer to the scale problem. Although photographic reduction is acceptable, photographic enlargement may introduce inaccuracies and result in an unwarranted extrapolation of the data.

The accuracy of the surficial geology map is the limiting factor in the application of environmental geology in De Kalb County. The United States Department of Agriculture, Soil Conservation Service, is currently preparing a modern soil map for the county. Close cooperation between soil scientists and geolgists can result in improved accuracy in both the resultant soil and geologic maps (McComas, Hinkley, and Kempton, 1969), which in turn will allow more accuracy in the various environmental maps of this area.

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